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# DATA SHEET

# BLF246
## VHF power MOS transistor

Product specification
Supersedes data of September 1992

1996 Oct 21

Philips
Semiconductors

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# VHF power MOS transistor BLF246

## FEATURES

- High power gain
- Low noise figure
- Easy power control
- Good thermal stability
- Withstands full load mismatch.

## APPLICATIONS

- Large signal amplifier applications in the VHF frequency range.

## DESCRIPTION

Silicon N-channel enhancement mode vertical D-MOS transistor encapsulated in a 4-lead, SOT121 flange package, with a ceramic cap. All leads are isolated from the flange. A marking code, showing gate-source voltage ($V_{GS}$) information is provided for matched pair applications. Refer to the General section of Data Handbook SC19a for further information.

| CAUTION |
|---|
| The device is supplied in an antistatic package.<br>The gate-source input must be protected against static discharge during transport or handling. |

## PINNING - SOT121

| PIN | SYMBOL | DESCRIPTION |
|---|---|---|
| 1 | d | drain |
| 2 | s | source |
| 3 | g | gate |
| 4 | s | source |

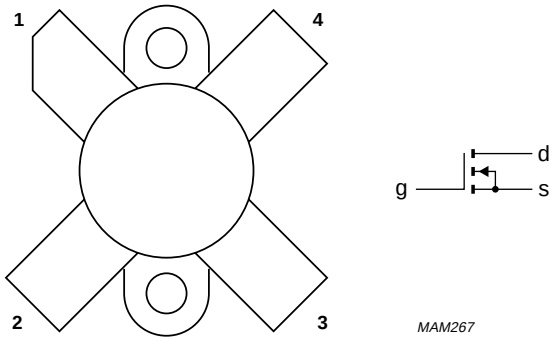



Fig.1 Simplified outline and symbol.

## QUICK REFERENCE DATA

RF performance at $T_h$ = 25 °C in a common source test circuit.

| MODE OF OPERATION | f (MHz) | $V_{DS}$ (V) | $P_L$ (W) | $G_p$ (dB) | $\eta_D$ (%) |
|---|---|---|---|---|---|
| CW, class-B | 108 | 28 | 80 | ≥16 | ≥55 |

| WARNING |
|---|
| **Product and environmental safety - toxic materials** |
| This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions. After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with the general or domestic waste. |

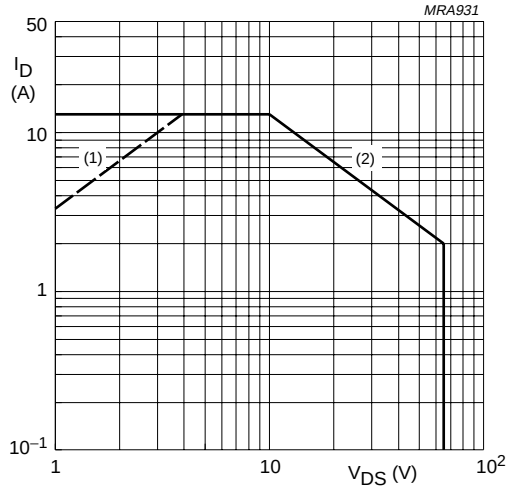
## LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134).

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | | – | 65 | V |
| $V_{GS}$ | gate-source voltage | | – | ±20 | V |
| $I_D$ | DC drain current | | – | 13 | A |
| $P_{tot}$ | total power dissipation | up to $T_{amb}$ = 25 °C | – | 130 | W |
| $T_{stg}$ | storage temperature | | −65 | 150 | °C |
| $T_j$ | junction temperature | | – | 200 | °C |

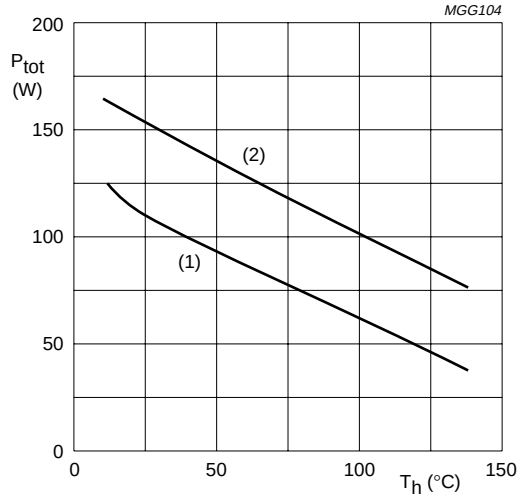
## THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | VALUE | UNIT |
|---|---|---|---|
| $R_{th\ j\text{-}mb}$ | thermal resistance from junction to mounting base | 1.35 | K/W |
| $R_{th\ mb\text{-}h}$ | thermal resistance from mounting base to heatsink | 0.2 | K/W |




(1) Current is this area may be limited by $R_{DS(on)}$.
(2) $T_{mb}$ = 25 °C.

Fig.2 DC SOAR.



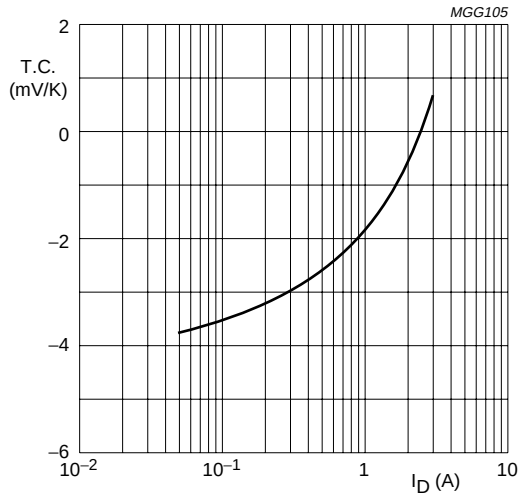

(1) Continuous operation.
(2) Short-time operation during mismatch.

Fig.3 Power derating curves.

## CHARACTERISTICS

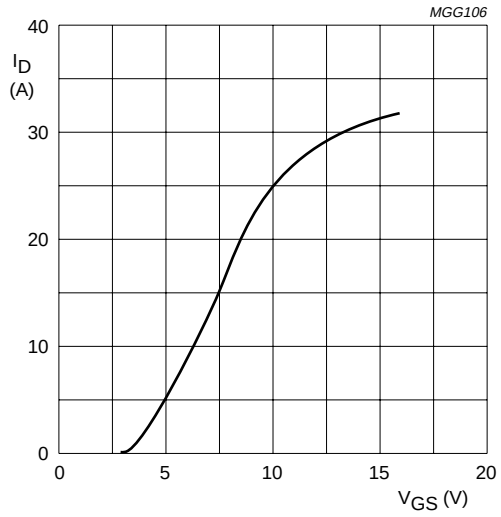
$T_j$ = 25 °C unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $V_{GS}$ = 0; $I_D$ = 50 mA | 65 | – | – | V |
| $I_{DSS}$ | drain-source leakage current | $V_{GS}$ = 0; $V_{DS}$ = 28 V | – | – | 2.5 | mA |
| $I_{GSS}$ | gate-source leakage current | $V_{GS}$ = ±20 V; $V_{DS}$ = 0 | – | – | 1 | µA |
| $V_{GSth}$ | gate-source threshold voltage | $I_D$ = 50 mA; $V_{DS}$ = 10 V | 2 | – | 4.5 | V |
| $\Delta V_{GS}$ | gate-source voltage difference of matched pairs | $I_D$ = 50 mA; $V_{DS}$ = 10 V | – | – | 100 | mV |
| $g_{fs}$ | forward transconductance | $I_D$ = 2.5 A or 5 A; $V_{DS}$ = 10 V | 3 | 4.2 | – | S |
| $R_{DSon}$ | drain-source on-state resistance | $I_D$ = 5 A; $V_{GS}$ = 10 V | – | 0.2 | 0.3 | Ω |
| $I_{DSX}$ | on-state drain current | $V_{GS}$ = 10 V; $V_{DS}$ = 10 V | – | 22 | – | A |
| $C_{is}$ | input capacitance | $V_{GS}$ = 0; $V_{DS}$ = 28 V; f = 1 MHz | – | 225 | – | pF |
| $C_{os}$ | output capacitance | $V_{GS}$ = 0; $V_{DS}$ = 28 V; f = 1 MHz | – | 180 | – | pF |
| $C_{rs}$ | feedback capacitance | $V_{GS}$ = 0; $V_{DS}$ = 28 V; f = 1 MHz | – | 25 | – | pF |



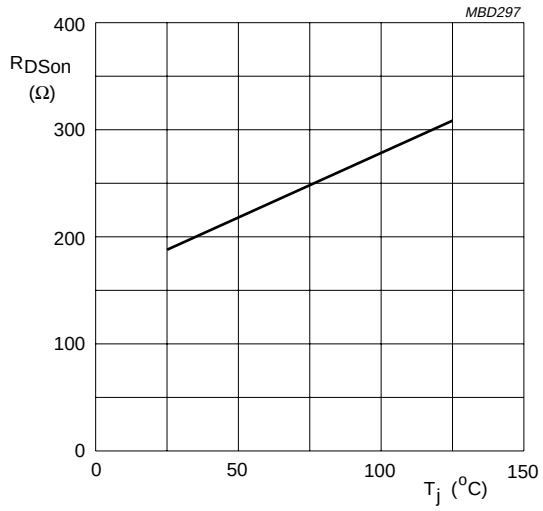

$V_{DS}$ = 10 V; valid for $T_h$ = 25 to 70 °C.

Fig.4 Temperature coefficient of gate-source voltage as a function of drain current, typical values.



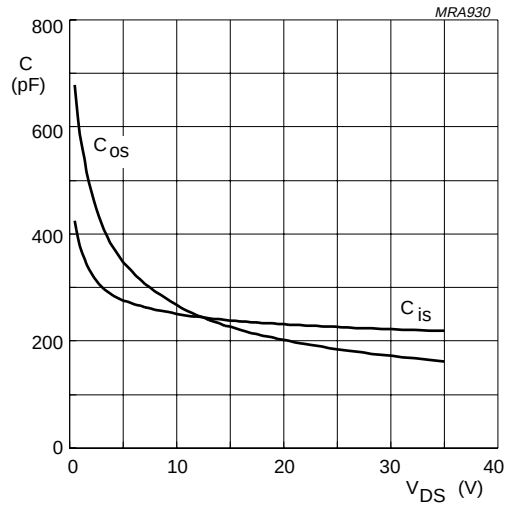

$V_{DS}$ = 10 V; $T_j$ = 25 °C.

Fig.5 Drain current as a function of gate-source voltage, typical values.



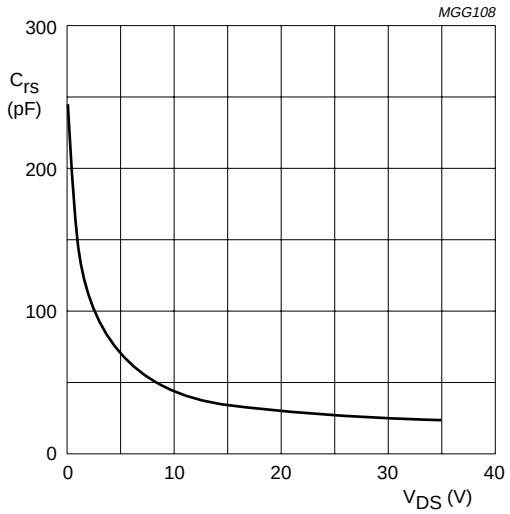

$V_{GS}$ = 10 V; $I_D$ = 5 A.

Fig.6 Drain-source on-state resistance as a function of junction temperature, typical values.




$V_{GS}$ = 0; f = 1 MHz.

Fig.7 Input and output capacitance as functions of drain-source voltage, typical values.




$V_{GS}$ = 0; f = 1 MHz.

Fig.8 Feedback capacitance as a function of drain-source voltage, typical values.

## APPLICATION INFORMATION

RF performance in CW operation in a common source test circuit.
$T_h$ = 25 °C; $R_{th\ mb\text{-}h}$ = 0.2 K/W; $R_{GS}$ = 12 Ω unless otherwise specified.

| MODE OF OPERATION | f (MHz) | $V_{DS}$ (V) | $I_D$ (A) | $P_L$ (W) | $G_p$ (dB) | $\eta_D$ (%) |
|---|---|---|---|---|---|---|
| CW, class-B | 108 | 28 | 0.1 | 80 | >16 | >55 |
| CW, class-B | 108 | 28 | 0.1 | 80 | typ. 18 | typ. 65 |
| CW, class-C | 108 | 28 | 0(1) | 80 | typ. 15 | typ. 72 |

**Note**

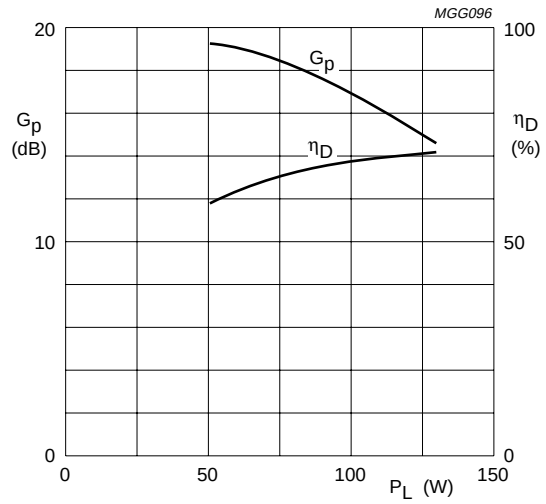
1. $V_{GS}$ = 0 (class-C).

### Ruggedness in class-B operation

The BLF246 is capable of withstanding a load mismatch corresponding to VSWR = 50: 1 through all phases under the following conditions: $V_{DS}$ = 28 V; f = 108 MHz; $T_h$ = 25 °C; $R_{th\ mb\text{-}h}$ = 0.2 K/W at rated output power.

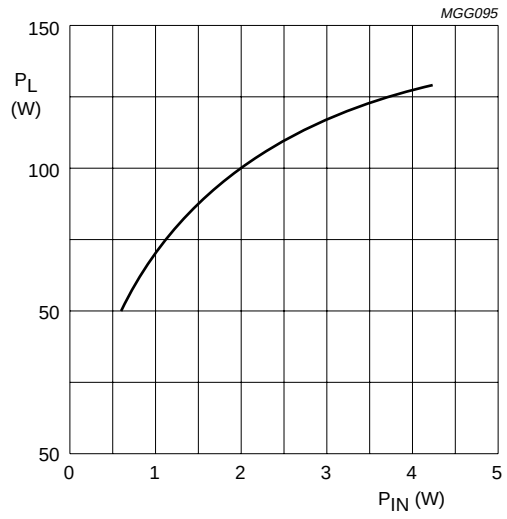
### Noise figure

Measured with 80 W power-matched source and load in the test circuit (see Fig.9) with $V_{DS}$ = 28 V; $I_D$ = 2 A; f = 108 MHz; $R_{GS}$ = 27 Ω; $T_h$ = 25 °C; $R_{th\ mb\text{-}h}$ = 0.2 K/W; F = typ. 3 dB.




Class-B operation; $V_{DS}$ = 28 V; $I_{DQ}$ = 0.1 A; $R_{GS}$ = 12 Ω; f = 108 MHz; $T_h$ = 25 °C; $R_{th\ mb\text{-}h}$ = 0.2 K/W.

Fig.9 Power gain and efficiency as functions of load power, typical values.




Class-B operation; $V_{DS}$ = 28 V; $I_{DQ}$ = 0.1 A; $R_{GS}$ = 12 Ω; f = 108 MHz; $T_h$ = 25 °C; $R_{th\ mb\text{-}h}$ = 0.2 K/W.

Fig.10 Load power as a function of input power, typical values.

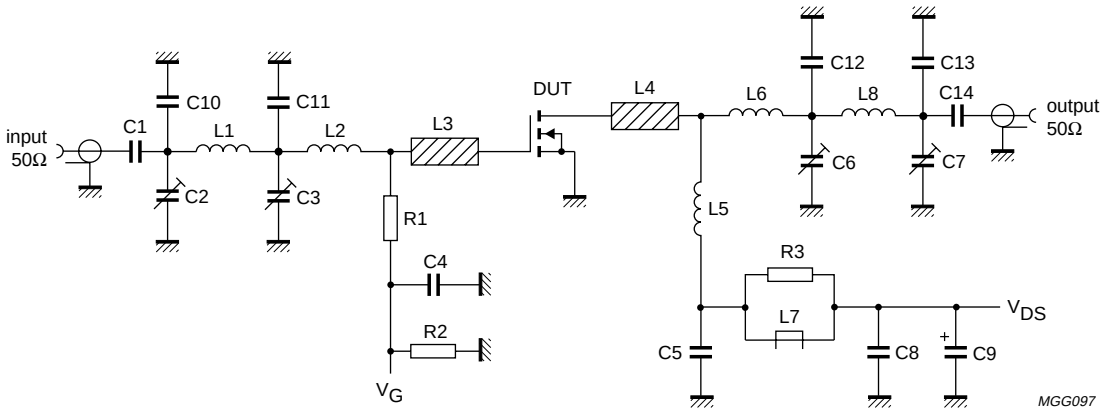


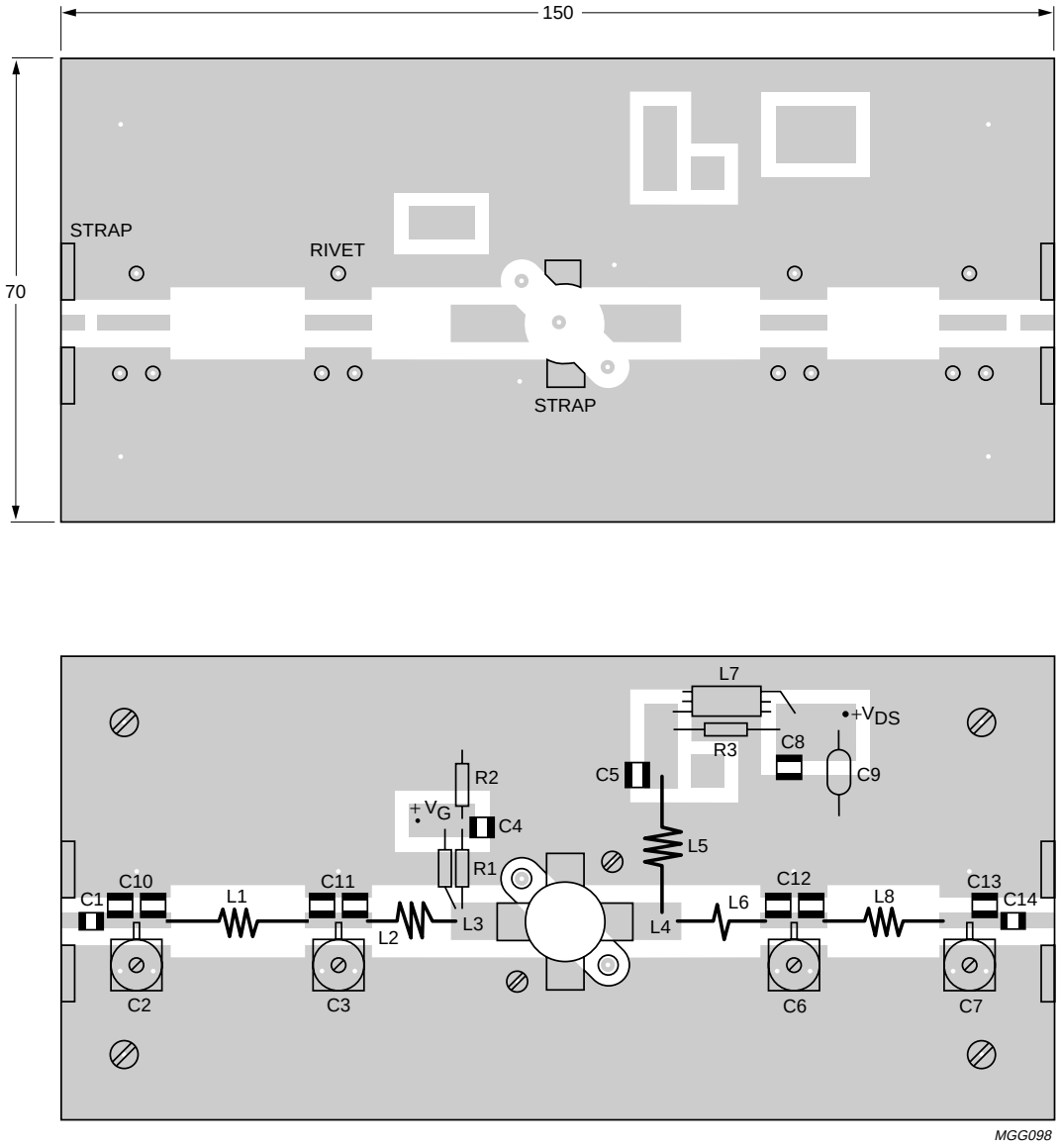

Fig.11 Test circuit for class-B operation at 108 MHz.

**List of components** (see Figs 11 and 12).

| COMPONENT | DESCRIPTION | VALUE | DIMENSIONS | CATALOGUE NO. |
|---|---|---|---|---|
| C1, C4, C5, C8, C14 | multilayer ceramic chip capacitor | 100 nF | | 2222 852 47104 |
| C2, C3, C6, C7 | film dielectric trimmer | 5 to 60 pF | | 2222 809 08003 |
| C9 | electrolytic capacitor | 2.2 μF, 63 V | | 2222 030 38228 |
| C10 | multilayer ceramic chip capacitor; note 1 | 68 pF + 39 pF in parallel | | |
| C11 | multilayer ceramic chip capacitor; note 1 | 69 pF + 100 pF in parallel | | |
| C12 | multilayer ceramic chip capacitor; note 1 | 2x 100 pF in parallel | | |
| C13 | multilayer ceramic chip capacitor; note 1 | 62 pF | | |
| L1 | 5 turns enamelled 0.6 mm copper wire | 52 nH | length 6.5 mm<br>int. dia. 3 mm<br>leads 2 × 10 mm | |
| L2 | 2 turns enamelled 0.6 mm copper wire | 19 nH | length 3.5 mm<br>int. dia. 3 mm<br>leads 2 × 7.5 mm | |
| L3, L4 | stripline; note 2 | 31 Ω | length 13 mm<br>width 6 mm | |
| L5 | 3 turns enamelled 1.6 mm copper wire | 36 nH | length 12 mm<br>int. dia. 6 mm<br>leads 2 × 5 mm | |
| L6 | hairpin of enamelled 1.6 mm copper wire | 14 nH | length 20 mm | |
| L7 | grade 3B Ferroxcube HF choke | | | 4312 020 36640 |
| L8 | 3 turns enamelled 1.6 mm copper wire | 52 nH | length 8 mm<br>int. dia. 6 mm<br>leads 2 × 9 mm | |
| R1 | metal film resistor | 2 × 24 Ω in parallel, 0.4 W | | |
| R2 | metal film resistor | 100 kΩ, 0.4 W | | |
| R3 | metal film resistor | 10 Ω, 0.4 W | | |

**Notes**

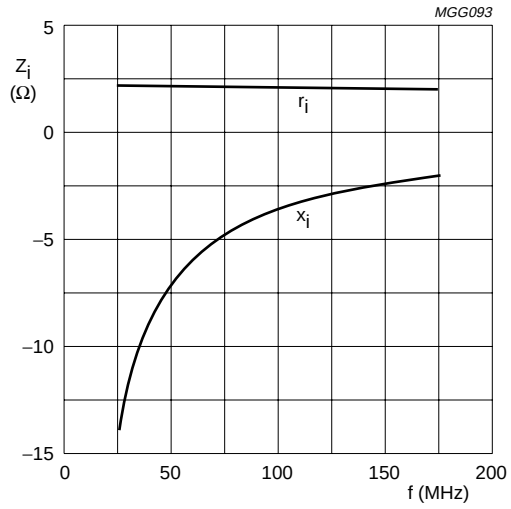
1. American Technical Ceramics capacitor, type 100B or other capacitor of the same quality.
2. The striplines are mounted on a double copper-clad PCB with epoxy fibre-glass dielectric ($\varepsilon_r$ = 4.5), thickness 1.6 mm.




Dimensions in mm.

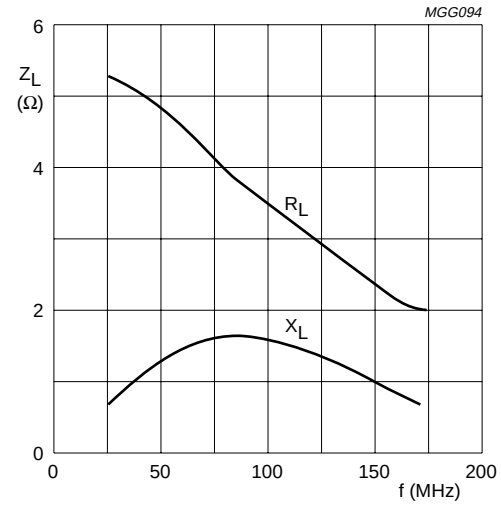
The circuit and components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as a ground. Earth connections are made by means of hollow rivets, whilst under the source leads, copper straps are used for a direct contact between the upper and lower sheets.

Fig.12 Component layout for 108 MHz class-B test circuit.



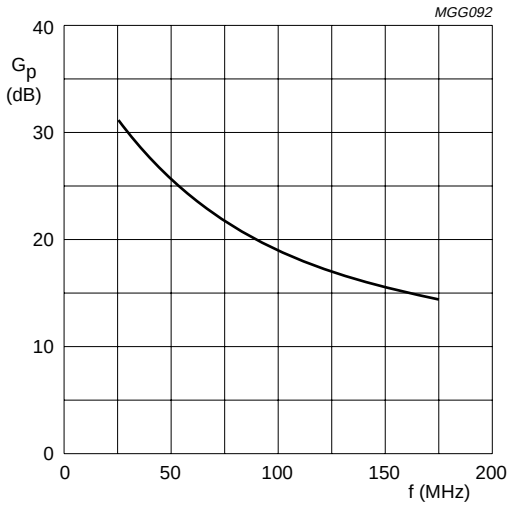

Class-B operation; $V_{DS}$ = 28 V; $I_{DQ}$ = 0.1 A; $R_{GS}$ = 12 Ω;
$P_L$ = 80 W; $T_h$ = 25 °C; $R_{th\ mb\text{-}h}$ = 0.2 K/W.

Fig.13 Input impedance as a function of frequency (series components), typical values.




Class-B operation; $V_{DS}$ = 28 V; $I_{DQ}$ = 0.1 A; $R_{GS}$ = 12 Ω;
$P_L$ = 80 W; $T_h$ = 25 °C; $R_{th\ mb\text{-}h}$ = 0.2 K/W.

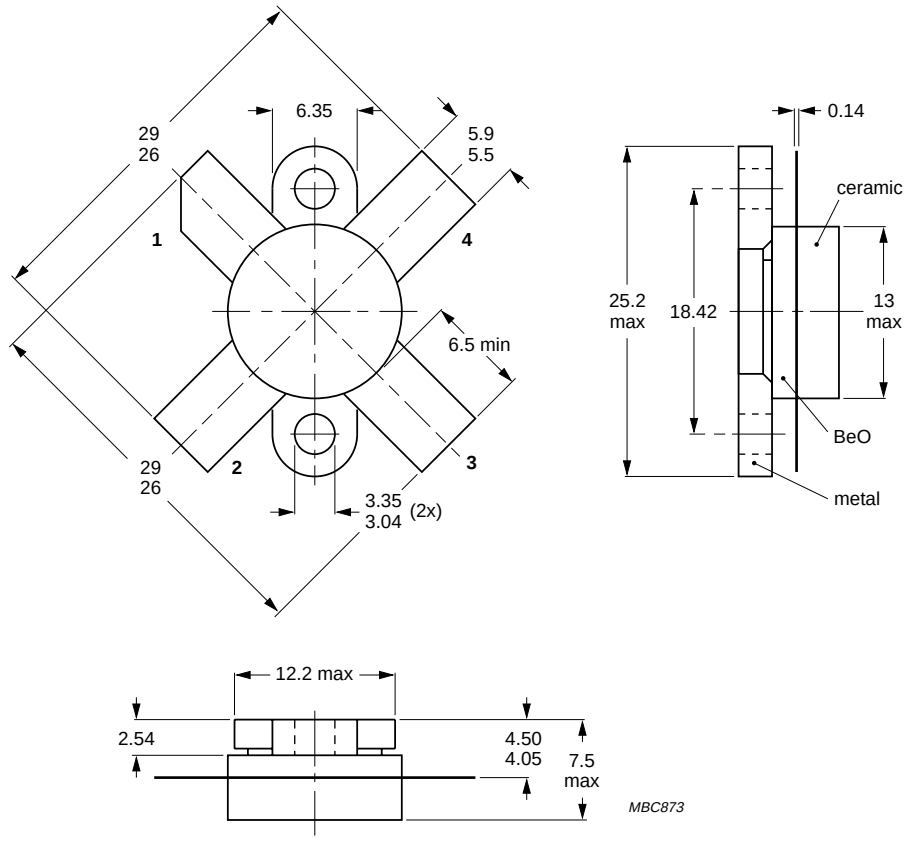
Fig.14 Load impedance as a function of frequency (series components), typical values.




Class-B operation; $V_{DS}$ = 28 V; $I_{DQ}$ = 0.1 A; $R_{GS}$ = 12 Ω;
$P_L$ = 80 W; $T_h$ = 25 °C; $R_{th\ mb\text{-}h}$ = 0.2 K/W.

Fig.15 Power gain as a function of frequency, typical values.

**PACKAGE OUTLINE**




Dimensions in mm.

Fig.16 SOT121.

## DEFINITIONS

| **Data Sheet Status** | |
|---|---|
| Objective specification | This data sheet contains target or goal specifications for product development. |
| Preliminary specification | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification | This data sheet contains final product specifications. |
| **Limiting values** | |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability. | |
| **Application information** | |
| Where application information is given, it is advisory and does not form part of the specification. | |

## LIFE SUPPORT APPLICATIONS

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